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BEVERAGE CONTAINER CLOSURE AND SEALANT LAYER MATERIAL

Field Of The Invention

The present invention relates to thermoplastic materials used to mold beverage container closures and sealant layers. More particularly, the present invention relates to thermoplastic materials having improved gas barrier properties.

Background Of The Invention

Beverage containers formed from moldable thermoplastic such as polyethylene terephthalate generally have a threaded opening that accommodates a threaded closure or cap. The closure is molded from thermoplastic materials such as polypropylene homopolymer, polypropylene copolymer, and high density polyethylene. A sealant layer or liner is generally interposed between the closure and the beverage container to prevent fluid leakage from or into the container.

An important property of beverage container closure and sealant layer materials is the barrier or permeability of the materials. In this regard, traditional polypropylene and polyethylene closure and sealant materials were developed without primary regard for their gas barrier properties. More recently, efforts have been made to develop improved closure and sealant materials having lower permeability to oxygen and carbon dioxide. Such improved materials would be preferred for beverage containers, especially carbonated beverage containers, for which extended shelf life and beverage quality is demanded.

It has been found that the addition of

nanocomposite, montmorillonite clay to thermoplastic materials used in the molding of beverage container closures and sealant layers improves the barrier properties of the materials. Specifically, the addition of montmorillonite clay decreases the permeability of such thermoplastic materials to oxygen and carbon dioxide.

Summary Of The Invention

A melt-processible composition for molding closures for beverage containers has improved gas barrier properties. The composition comprises:

(a) a thermoplastic base polymeric material;

(b) a quantity of layered magnesium aluminum silicate clay having platelets with a diameter of approximately 1 micron.

In the preferred closure composition, the thermoplastic base polymeric material comprises a polyolefin such as polypropylene, polyethylene and/or a copolymer comprising propylene and ethylene monomeric units.

The layered magnesium aluminum silicate clay is preferably a nanocomposite, montmorillonite clay.

A melt-processible composition for molding sealant layers for beverage containers also has improved gas barrier properties. The composition comprises:

(a) a thermoplastic base polymeric material;

(b) a quantity of layered magnesium aluminum silicate clay having platelets with a diameter of approximately 1 micron.

In the preferred sealant layer composition, the thermoplastic base polymeric material comprises ethyene

vinyl acetate copolymer, polyethylene (linear low density polyethylene, low density polyethylene, ultra-low density polyethylene, and high density polyethylene), styrene ethylene butadiene styrene polymer (commercially available from Shell under the trade designation KRATON®), styrene butadiene styrene polymer, ethylene propylene diene monomer, and metallocene polymers. The layered magnesium aluminum silicate clay is preferably nanocomposite, montmorillonite clay.

A method of decreasing the gas permeability of a thermoplastic material comprises introducing a quantity of layered magnesium alumnium silicate clay into the material. The preferred magnesium aluminum silicate clay is nanocomposite, montmorillonite clay.

Detailed Description Of The Preferred Embodiments

Polypropylene-based thermoplastic compositions, suitable for molding beverage container closures, were prepared using the following formulations:

Sample No. 98-006 control:

Material	Chemical Composition	Parts by Weight
Montell CA 012	Polypropylene copolymer	97
5019466JEMB	White color masterbatch	3

Sample No. 98-006 B:

Material	Chemical Composition	Parts by Weight
Montell CA 012	Polypropylene copolymer	95
5019466JEMB	White color masterbatch	3
Cloisite 25 A	Nanocomposite clay	3 to 10

The oxygen permeability for plaques (30 mils nominal thickness) of each of the above samples was measured on a Mocon Ox-Tran 10/50A analyzer at 23.2°C and 0% relative

humidity. The system was purged for 2 hours and each plaque was conditioned in a 100% oxygen atmosphere overnight prior to testing. Test area was 50 cm^2. Oxygen permeability was measured on three plaques for each sample and the results were averaged and reported below:

Sample	Oxygen Permeability ($cc/m^2/day$)
98-006 control	110.8
98-006 B	90.6

The above results showed that the addition of nanocomposite, montmorillonite clay to the polypropylene copolymeric thermoplastic base material decreased the oxygen permeability of the material by approximately 18%.

Ethylene-vinyl acetate (EVA) thermoplastic compositions, suitable for molding beverage container liners, were prepared using the following formulations:

Sample No. 240-6C control:

Material	Chemical Composition	Parts by Weight
UE 655	9% EVA 2 melt index	15
UE 635	9% EVA 9.8 melt index	85
Escorene 3505G	Polypropylene homopolymer 400 melt index	5
Crodamine ER	Erucamide	1
Aldo MS	Glycerol monostearate	0.1

Sample No. 97-692:

Material	Chemical Composition	Parts by Weight
UE 655	9% EVA 2 melt index	5 to 15
UE 635	9% EVA 9.8 melt index	80 to 100
Escorene 3505G	Polypropylene homopolymer 400 melt index	3 to 10
Crodamine ER	Erucamide	0.5 to 2.0

Cloisite 25 A	Nanocomposite clay	3 to 10
Aldo MS	Glycerol monostearate	0.1 to 0.5

The oxygen permeability for plaques (30 mils nominal thickness) of each of the above samples was measured on a Mocon Ox-Tran 10/50A analyzer at 23.2°C and 0% relative humidity. The system was purged for 2 hours and each plaque was conditioned in a 100% oxygen atmosphere overnight prior to testing. Test area was 50 cm^2. Oxygen permeability was measured on three plaques for each sample and the results were averaged and reported below:

Sample	Oxygen Permeability ($cc/m^2/day$)
240-6C control	343.8
97-692	302.2

The above results showed that the addition of montmorillonite clay to the EVA thermoplastic base material decreased the oxygen permeability by approximately 12%.

The permeability to carbon dioxide, as measured in % gas loss/day, improved approximately 15% (<u>i.e.</u>, the % gas loss/day decreased approximately 15%) with the addition of nanocomposite, montmorillonite clay.